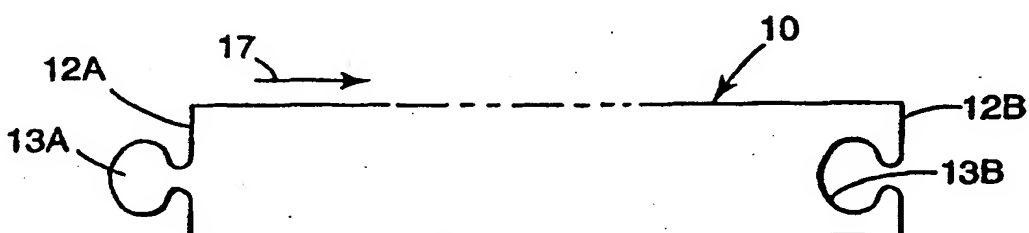




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : B24D 11/06, 9/00	A1	(11) International Publication Number: WO 97/38825 (43) International Publication Date: 23 October 1997 (23.10.97)
(21) International Application Number: PCT/US97/05627 (22) International Filing Date: 3 April 1997 (03.04.97) (30) Priority Data: 9607885.2 16 April 1996 (16.04.96) GB (71) Applicant (for all designated States except US): MINNESOTA MINING AND MANUFACTURING COMPANY [US/US]; 3M Center, P.O. Box 33427, Saint Paul, MN 55133-3427 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): STUBBS, Roy [GB/GB]; 58 Shakespeare Drive, Nuncaton, Warwickshire CV11 6NW (GB). TANDY, Christopher [GB/GB]; 69 Leicester Road, Ashby De La Zouch, Leicestershire LE65 1DD (GB). WILLCOCK, John, N. [GB/GB]; 79 Sir Alfred's Way, Sutton Coldfield, West Midlands B76 1EQ (GB). (74) Agents: TRUSSELL, James, J. et al.; Minnesota Mining and Manufacturing Company, Office of Intellectual Property Counsel, P.O. Box 33427, Saint Paul, MN 55133-3427 (US).		(81) Designated States: US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>
(54) Title: ABRASIVE MEMBERS FOR ENDLESS ABRASIVE SURFACES  (57) Abstract An abrasive belt is formed by releasably-attaching a length of abrasive material (10) to an endless backing belt (11). The ends (12A, 12B) of the length of abrasive material are preferably shaped so that they interlock.		

BEST AVAILABLE COPY

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

ABRASIVE MEMBERS FOR ENDLESS ABRASIVE SURFACES

TECHNICAL FIELD

5 The present invention relates to abrasive members suitable, in particular, for providing endless abrasive surfaces (for example endless abrasive belts) such as may be found in abrading machines of various types.

BACKGROUND OF THE INVENTION

10 Powered sanding and grinding machines which employ abrasive belts are available in many different forms for a wide variety of applications. Generally, the endless abrasive belt is mounted around rollers at least one of which is driven so that the belt can be rotated and apply an abrasive action to a workpiece. Machines which employ some form of rotatable drum, instead of a belt, to provide the endless abrasive surface are also known and are also available in many different forms.

15 DE-C-40 32 889 describes a drum sander in which the abrasive surface is provided by an abrasive belt releasably fastened on the outer surface of a drum body. The abrasive belt is open-ended and is wrapped around the surface of the drum. To secure the belt to the drum, the surface of the latter is covered with barbs which interlock with a loop fabric on the back of the abrasive belt.

20

SUMMARY OF THE INVENTION

The present invention provides an abrading machine comprising an endless backing belt, and an abrasive member positioned around and releasably attached to the backing belt to provide a continuous abrasive surface on the backing belt.

25 Preferably, the opposite ends of the length of sheet material are contoured so that they interlock.

The invention also provides an abrading machine comprising an endless rotatable backing surface, and an abrasive member positioned around and releasably-attached to the backing surface, wherein the opposite ends of the
30 abrasive member are contoured so that they interlock to provide a continuous abrasive surface on the backing surface.

The invention further provides an abrasive belt support and drive system for use with an abrading machine, the system comprising:

- a. a first roller configured to support a backing surface at rest and during rotation;
- 5 b. an endless rotatable backing surface including a front surface for supporting an abrasive belt and a back surface for engagement with the first roller, wherein the backing surface is disposed around the first roller;
- c. a length of abrasive material including a first end and a second end, a front surface for abrading a workpiece and a back surface for engagement with the
10 backing surface, the abrasive material being positioned around and releasably attached to the front surface of the backing surface, to provide a continuous abrasive surface on the backing surface. Advantageously, the first and second ends of the length of abrasive material are interlocked, and are contoured such that the first and second ends may be disengaged by lifting one of the ends out of the plane
15 of the other end.

In accordance with another aspect of the invention, there is provided an abrasive belt comprising an endless backing belt, and an abrasive member positioned around and releasably-attached to the backing belt to provide a continuous abrasive surface on the backing belt. Preferably, the opposite ends of the length of sheet
20 material are contoured so that they interlock.

The invention further provides an abrasive belt comprising an endless backing belt having a front surface, and a length of abrasive material having a first end, a second end, a front surface for abrading a workpiece, and a back surface for engaging the backing belt, the abrasive material positioned around and releasably-
25 attached to the front surface of the backing belt, to provide a continuous abrasive surface on the backing belt. Advantageously, the first and second ends of the length of abrasive material are contoured so that they interlock such that either of the first and second ends can be lifted out of the plane of the other end to disengage the first and second ends.

30 In accordance with yet another aspect of the invention, there is provided for use in combination with an endless backing belt, an abrasive member suitable for

attachment to the backing belt, the back of the abrasive member being formed for releasable attachment to the backing belt and having a length which is sufficient to enable the sheet material to be positioned around the backing belt to provide a continuous abrasive surface on the backing belt.

5 The invention also provides an abrasive member suitable for attachment to an endless backing surface, the back of the abrasive member being formed for releasable attachment to a backing surface and having a length which is sufficient to enable the abrasive member to be positioned around an endless backing surface, wherein the opposite ends of the length of sheet material are contoured so that they
10 interlock.

 The invention further provides abrasive material suitable for attachment to an endless backing surface, comprising first and second ends, a front surface for abrading a workpiece, and a back surface opposite the front surface, the back of the abrasive material being formed for releasable attachment to a backing surface and
15 having a length which is sufficient to enable the abrasive material to be positioned around an endless backing surface. Advantageously, the first and second ends of the length of abrasive material are contoured so that they interlock.

BRIEF DESCRIPTION OF THE DRAWINGS

20 By way of example only, embodiments of the invention will be described with reference to the accompanying drawings, in which:

 Fig. 1 illustrates, diagrammatically, one form of abrading machine employing an endless abrasive belt;

 Fig. 2 shows a plan view of an abrasive member in accordance with the
25 present invention;

 Fig. 3 is a diagrammatic side view of a backing belt for use with the abrasive member of Fig. 2;

 Fig. 4 illustrates, diagrammatically, the construction of an abrasive belt in accordance with the invention;

30 Fig. 5 illustrates, diagrammatically, the construction of the abrasive member of Fig. 2;

Fig. 6 illustrates, diagrammatically, the construction of the backing belt of Fig. 3; and

Fig. 7 shows a plan view of part of the abrasive belt of Fig. 4.

5 DETAILED DESCRIPTION OF THE INVENTION

The machine illustrated in Fig. 1 may be one part of a backstand machine and comprises an endless abrasive belt 1 mounted around rollers 2a and 2b respectively, one of which is driven by a motor (not shown) to rotate the belt and thereby apply an abrasive action to a workpiece 3. For clarity, only the rollers 2a and 2b are illustrated. The configuration and construction of abrading machines of the type employing rollers such as 2a and 2b is well known in the art and need not be further described herein. Together, the rollers 2a and 2b, and the abrasive belt 1 will be referred to herein as an abrasive belt support and drive system 8.

The machine referred to in Fig. 1 is just one of many known types of abrading machine, which employ abrasive belts. Typically, the belt is a coated abrasive having a backing which is appropriate to the intended use of the belt. The backing may, for example, be a fabric formed from natural materials, for example cotton, and/or synthetic materials, for example nylon or polyester. Different abrading machines generally require belts of different sizes, and different applications of the same machine require abrasive belts of different grades. An abrasive belt must, of course, be replaced when it becomes worn but may also have to be changed, before it becomes worn, if a belt of a different grade is required.

Fig. 2 shows an abrasive member 10 for use in combination with a non-abrasive backing belt 11 (Fig. 3) to provide an alternative form of abrasive belt. The backing belt 11 will be described in greater detail below. The abrasive member 10, which is shown separate from the belt 11 in Fig. 2, is intended to be releasably-attached along its non-abrasive back side to the belt and is of the same length as the latter. In addition, the ends 12A, 12B of the abrasive member 10 are of a shape configured to interlock and provide a continuous abrasive surface on the backing belt in an interlocked arrangement which cannot be easily disengaged unless one of the ends is moved vertically out of the plane of the other end. For example, the end

12A of the member 10 is formed with a bulbous projection 13A which is shaped to fit into a correspondingly-shaped notch 13B in the other end 12B (i.e. the ends have a jig-saw shape).

5 The backing belt 11, shown in Fig. 3, is an endless rotatable belt mounted around rollers 14a and 14b in an abrading machine. The abrading machine may, for example, have the roller arrangement of the type illustrated in Fig. 1 in which case the rollers 14a and 14b correspond respectively to the rollers 2a and 2b.

10 The backing belt 11 is formed from any suitable material, preferably a comparatively heavy-duty, durable material. Suitable materials for the backing belt 11 are cloth and other sheet materials, for example paper, plastic film, leather, etc. When cloth is used for the backing belt 11 it may be woven or non-woven and may be formed from natural fibers (for example cotton) and/or synthetic fibers (for example polyester, nylon). The cloth may be impregnated or saturated with curable resins to confer additional strength and water/oil repellence. Generally, any material
15 used as the backing of a conventional abrasive belt could be useful for the backing belt 11 of Fig. 3. However, other materials can also be used, as noted below.

The abrasive member 10 may be any suitable abrasive material covered, on its back surface, with one part of a mating surface attachment surface, e.g. a hook and loop attachment system while the backing belt 11 is covered, on its front
20 surface, with the other part of the mating surface attachment system. In the particular embodiment illustrated in Figs. 5 and 6, the abrasive member 10 comprises a conventional coated abrasive sheet material 15 the back surface of which is laminated to a loop fabric component 16 of a hook and loop attachment system, and the backing belt 11 carries on its front surface the hooked component
25 17 of the attachment system. To attach the abrasive member 10 to the backing belt 11, it is necessary only to position the abrasive member 10 so that it extends completely around the belt 11 and then to press the abrasive member in position with the ends 12A, 12B interlocked as shown in Fig. 7. The engagement of the back surface of the abrasive 10 with the front surface of backing belt 11 is partially
30 illustrated in Fig. 4.

Preferably, the abrasive member 10 is positioned on the belt 11 so that the projection 13A is directed against the direction of movement of the belt 11 when in use. In Figs. 2 and 7, that direction of movement is indicated by the arrow 18.

5 The shaped ends 12A, 12B of the abrasive member 10 may be produced by a die cutting operation and need not have the particular form shown in Fig. 2. Any regular, or irregular, convoluted shape (including straight-sided shapes) could be used to provide the ends of the abrasive member 10 with projections and recesses which fit together.

10 It has been found that the interlocking ends 12A, 12B on the abrasive member 10 reduce any risk of the abrasive member coming away from the backing belt 11 during use. In some cases, however, depending on the nature of the abrasive member 10 and the attachment system between the abrasive member and the backing belt 11 it may be possible to omit the interlocking shaping of the ends 12A, 12B.

15 It will be appreciated that, when abrasive member 10 as shown in Fig. 1 is used to provide the abrasive surface of a belt in an abrading machine, the associated backing belt 11 can remain in position in the machine as shown in Fig. 3. The abrasive member 10 can easily be removed from the backing belt 11 and replaced when necessary (for example, because the abrasive surface is worn or because a
20 different grade of abrasive is required). Because the backing belt 11 can remain in position, it need not be as easy to handle as a conventional abrasive belt and can, therefore, be formed from a much heavier duty material or even from a material which might be unsuitable as a backing for a coated abrasive. For example, the backing belt 11 could be formed from an elasticized material to enable it to be
25 comparatively easy to place in position around the rollers 14 in the abrading machine while ensuring that, once in position, it will fit tightly around the rollers.

As illustrated in Fig. 7, the abrasive member 10 can be narrower than the backing belt 11, thereby enabling substantial savings to be achieved in the case in which, when using a conventional abrasive belt, the whole width of the belt would
30 not be required.

Alternatively, two or more parallel abrasive members (which need not be of the same grade) can be located on the same backing belt. In that case, adjacent side edges of the abrasive members could be shaped so that they interlock, in a similar manner to the ends 12A, 12B.

5 The abrasive member 10 may be any suitable material presenting an abrasive surface. It may, for example, be a coated abrasive comprising a substrate (for example paper, polymeric film, sponge material, cloth), which may be in sheet form and which has abrasive grit particles bonded to it. Alternatively, it may be a non-woven abrasive comprising a substrate (which may be in sheet form) of a porous,
10 fibrous, non-woven construction, with abrasive grit particles on one side of the substrate. The first part of the mating surface attachment system, e.g. the loop backing 16, is laminated to the back of the coated abrasive. Alternatively, the abrasive may be coated directly onto the first part of the attachment system 16 which thus forms the substrate of the abrasive sheet material. Generally, the
15 abrasive member 10 may be a less costly type of abrasive than those generally employed for abrasive belts since it does not have to withstand the same tensile forces.

 Likewise, the second part of the mating surface attachment system, e.g. the hooked surface 17 on the backing belt 11, may be laminated to the belt, or may
20 form an integral part of the belt. In a particular case, the belt 11 may actually be formed from the hooked material that provides the hooked part of the attachment system.

 The use of a hook and loop type of attachment system to secure the abrasive member 10 to the backing belt 11 is not essential. Any other suitable means can be
25 used to secure the abrasive member 10, provided that it permits the abrasive member to be removed and replaced without damage either to the abrasive member or to the backing belt 11 while ensuring that the abrasive member remains firmly attached while the belt is in use. For example, a suitable repositionable adhesive could be used to secure the abrasive member 10 to the backing belt 11, the adhesive
30 preferably being carried by the abrasive member. In that case, the abrasive member

10 may be provided with a backing sheet which protects the adhesive and is removed before the abrasive member is secured to the backing belt 11.

When a hook and loop type of attachment system is used, suitable loop fabrics 16 include looped stitched materials generally; brushed nylon, materials
5 available under the trade name "Kanebo"; and materials available under the trade name "Velcro."

Another suitable loop material is one which can be made by stitching loops into a substrate with commercially available chenille stitch machines. The substrate can be any suitable substrate to which a strand may be stitched to form a plurality of
10 loops. The substrate should be chosen to allow the needle to penetrate the substrate when forming loops; to provide adequate support for the loops, to provide an adequate bond with an adhesive layer described in more detail below, and to avoid picking and snagging by the needle when the forming loops. Preferred materials for the substrate include woven fabrics such as polyester, fortrel polyester,
15 gabardine, 65/35 polyester/cotton blend poplin, rip stop nylon, cotton canvas, polyester double knit, 50/50 cotton/polyester blend, cotton twill, and woven cellulosic fabric, such as cotton or rayon, in a 2 over 1 twill weave having a weight of 165 grams/meter².

In general, the loops are formed by repeatedly piercing the substrate and
20 causing portions of the strand to extend through the substrate with a suitable needle, thereby forming a plurality of loops formed from a continuous strand. This type of stitch is generally referred to as a drop stitch or a moss stitch. The result is a series of free standing loops made from a single continuous strand. The loops are generally oriented in the direction defined from hole to hole of adjacent loops.

25 Often, sewing and embroidery operations employ a second strand in a bobbin below the substrate which locks each individual stitch. However, the chenille stitch method described above does not lock each loop. Accordingly, the loops are connected to one another, but are not tied or locked in place. If one loop is pulled up through the substrate, it will pull the strand from adjacent loops. It is therefore necessary to lock all
30 of the loops in place. This is preferably done by adding adhesive layer to the back surface of the substrate after forming the loops. The adhesive should provide a strong

enough bond to lock the stitches and prevent pull out of loops during operation of the abrading machine and during removal and replacement of the abrasive member.

Suitable types of adhesives include, but are not limited to, polyolefins, polyesters, polyurethanes, polyamides, phenolic adhesives, urea-formaldehyde adhesives, epoxy
5 adhesives, acrylate adhesives, and the like.

With commercially available chenille machines, the substrate can be moved in any direction after each stitch. Thus, the loops can be made to have an orientation in any direction. This provides the ability to closely control the orientation of the loops and to stitch a loop material in which the loops are oriented in the same direction or in
10 different directions relative to one another by a desired amount.

Suitable hooked materials 17 are also available under the trade names "Kanebo" and "Velcro." Other suitable hook materials include those described in U.S. Patent No. 5,505,747 (Chesley et al.); U.S. Patent No. 5,077,870 (Melbye et al.); and in WIPO International Publication No. WO 95/19242.

It will be appreciated that it is not essential for the loop fabric 16 to be
15 carried by (or form part of) the abrasive member 10; the loop fabric 16 could instead be carried by (or form part of) the belt 11 with the hooked material 17 being carried by (or forming part of) the abrasive member 10.

Preferably the abrasive member 10 is attached to the backing belt 11 over
20 the whole of its rear surface.

As already mentioned, the abrading machine referred to with respect to Fig. 1; is an example of one of many different types of machines which use abrasive belts. Use of an abrasive member as shown in Fig. 2 in combination with a backing belt is, accordingly, not restricted to a machine of the type referred to with respect
25 to Fig. 1: a similar combination could be used in any machine employing an abrasive belt. Alternatively, an abrasive member having the form shown in Fig. 2 could be releasably attached to a rotatable drum (for example, in a drum sander) instead of an endless rotatable belt. Similar attachment systems can be used to those described above and, in the case of a two-part attachment system, one part would be provided
30 on the surface of the drum.

CLAIMS

1. An abrasive belt support and drive system for use with an abrading machine, the system comprising:
 - 5 a. a first roller configured to support a backing surface at rest and during rotation;
 - b. an endless rotatable backing surface including a front surface for supporting an abrasive belt and a back surface for engagement with the first roller, wherein the backing surface is disposed around the first roller;
 - 10 c. a length of abrasive sheet material including a first end and a second end, a front surface for abrading a workpiece and a back surface for engagement with the backing surface, the abrasive sheet being positioned around and releasably attached to the front surface of the backing surface, wherein the first and second
 - 15 ends are contoured such that the first and second ends may be disengaged by lifting one of the ends out of the plane of the other end, to provide a continuous abrasive surface on the backing surface.
2. A system as claimed in claim 1, including a second length of abrasive sheet
20 material which is also positioned around and releasably-attached to the front surface of the backing surface, the second length of material being parallel to the first-mentioned length of material.
3. A system as claimed in claim 1 or claim 2, including a second roller, wherein the
25 backing surface is an endless rotatable belt disposed about the first and second rollers.
4. A system as claimed in any one of the preceding claims, in which the abrasive
sheet material is a coated abrasive.

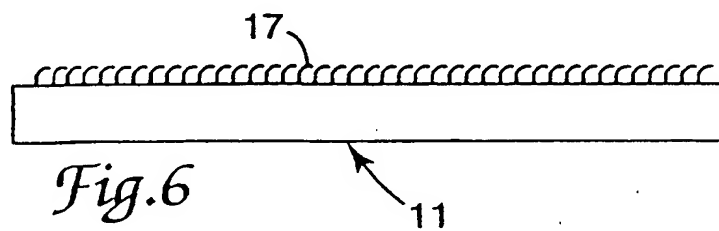
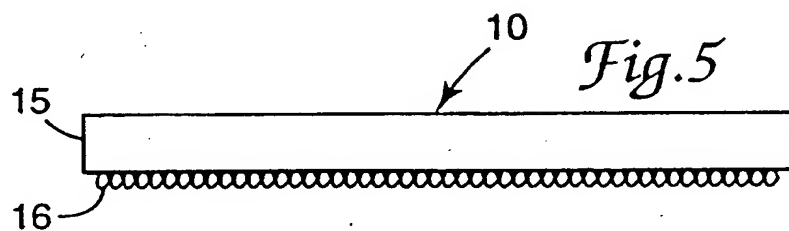
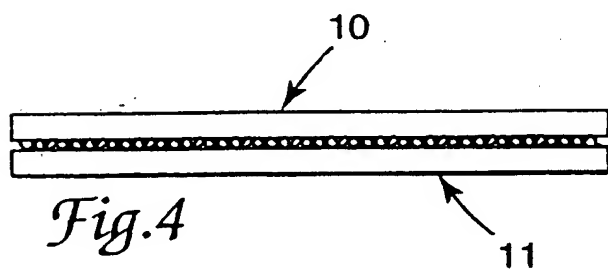
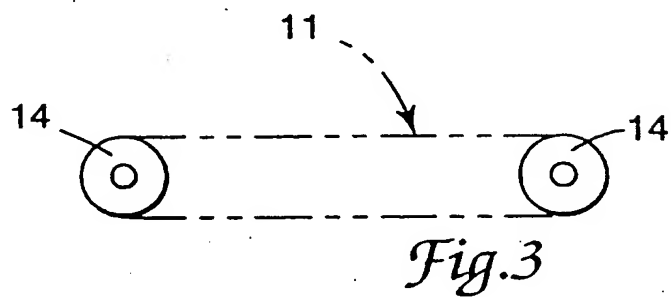
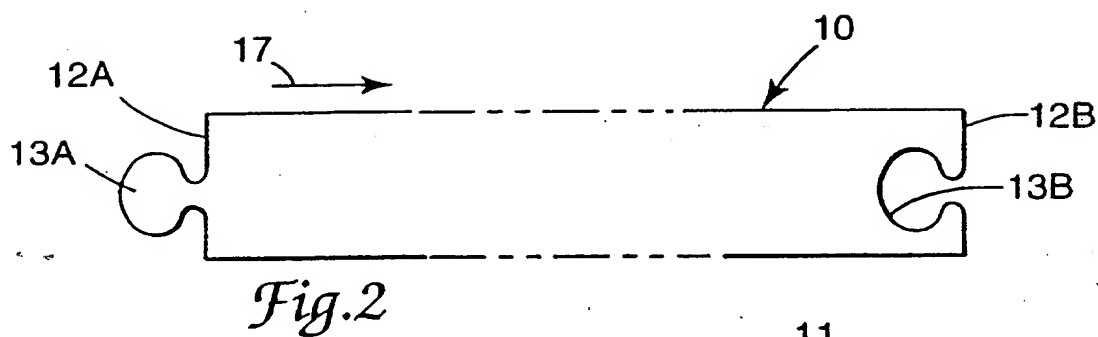
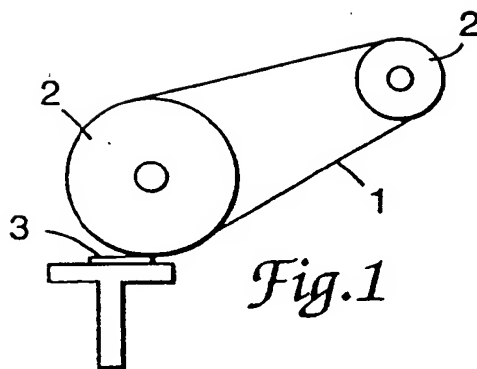
30

5. A system as claimed in any one of the preceding claims, in which the abrasive sheet material carries on its back surface one part of a two part attachment system and the backing surface carries on its front surface a mating part of the two-part attachment system, the sheet material being releasably-attached to the backing surface by the co-operation of the two parts of the attachment system.
6. A system as claimed in claim 5, in which the attachment system is a hook-and-loop attachment system.
7. A system as claimed in any one of claims 1 to 4, in which the back surface of the sheet material is releasably attached to the front surface of the backing surface by an adhesive.
8. A system as claimed in any one of the preceding claims, in which the sheet material is attached along its entire length to the backing surface.
9. A system as claimed in any one of the preceding claims, in which the first end of the length of sheet material is formed with a projection which is shaped to fit into an indent in the second end of the sheet material, the sheet material being attached to the backing surface so that the projection is directed against the direction of movement of the backing surface.
10. An abrasive belt comprising an endless backing belt having a front surface, and a length of abrasive sheet material having a first end, a second end, a front surface for abrading a workpiece, and a back surface for engaging the backing belt, the abrasive sheet material positioned around and releasably-attached to the front surface of the backing belt, wherein the first and second ends of the length of sheet material are contoured so that they interlock such that either of the first and second ends can be lifted out of the plane of the other end to disengage the first and second ends, and to provide a continuous abrasive surface on the backing belt when the first and second ends are interlocked.

11. An abrasive belt as claimed in claim 10, in which the abrasive sheet material is a coated abrasive.
- 5 12. An abrasive belt as claimed in claim 10 or claim 11, in which the abrasive sheet material carries on its back surface one part of a two-part attachment system and the front surface of the backing belt carries a second part of the two-part attachment system, the sheet material being releasably-attached to the backing belt by the co-operation of the two parts of the attachment system.
- 10 13. An abrasive belt as claimed in claim 12, in which the attachment system is a hook-and-loop attachment system.
14. An abrasive belt as claimed in claim 10 or claim 11, in which the sheet material
- 15 is releasably attached to the backing belt by an adhesive.
15. An abrasive belt as claimed in any one of claims 10 to 14, in which the sheet material is attached along its entire length to the backing belt.
- 20 16. Abrasive sheet material suitable for attachment to an endless backing surface, comprising first and second ends, a front surface for abrading a workpiece, and a back surface opposite the front surface, the back of the sheet material being formed for releasable attachment to a backing surface and having a length which is sufficient to enable the sheet material to be positioned around an endless backing
- 25 surface, wherein the first and second ends of the length of sheet material are contoured so that they interlock.
17. Abrasive sheet material as claimed in claim 16, the abrasive sheet material being a coated abrasive.

30

18. Abrasive sheet material as claimed in claim 16 or claim 17, in which the back surface of the sheet material is provided, over the whole length of the sheet material, with means for releasable attachment to a backing surface.
- 5 19. Abrasive sheet material as claimed in any one of claims 16 to 18, which carries on its back surface one part of a two-part attachment system.
20. Abrasive sheet material as claimed in claim 19, which carries on its back surface one part of a hook-and-loop attachment system.
- 10 21. Abrasive sheet material as claimed in any one of claims 16 to 18, which carries a repositionable adhesive on its back surface.
22. Abrasive sheet material substantially as described herein with reference to, and
15 as illustrated by, Figs. 2 and 5 of the accompanying drawings.
23. An abrasive belt comprising abrasive sheet material, as claimed in claim 22, releasably-attached to an endless backing belt.
- 20 24. An abrasive belt substantially as described herein with reference to, and as illustrated by, Figs. 2 to 6 of the accompanying drawings.
- 25 25. An abrasive belt support and drive system for use with an abrading machine including abrasive sheet material, as claimed in claim 22, releasably-attached to an endless rotatable backing surface.
26. An abrasive belt support and drive system for use with an abrading machine including an abrasive belt as claimed in claim 23 or claim 24.



INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/05627

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B24D11/06 B24D9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B24D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 32 46 395 A (LUSTIG LEO) 22 December 1983 see the whole document ---	1-26
Y	FR 508 111 A (SIA) 2 October 1920 see the whole document ---	1-26
A	DE 94 17 419 U (JOEST PETER) 2 March 1995 ---	
A	DE 89 04 270 U (ROLET MASCHINENBAU WOLFGANG MÜLLER) 24 May 1989 -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- *&* document member of the same patent family

Date of the actual completion of the international search

4 July 1997

Date of mailing of the international search report

25. 07. 97

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+ 31-70) 340-3016

Authorized officer

Eschbach, D

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 97/05627

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3246395 A	22-12-83	NONE	
FR 508111 A	02-10-20	NONE	
DE 9417419 U	02-03-95	NONE	
DE 8904270 U	24-05-89	NONE	

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**

☒ **OTHER:** dirty

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.